Menlo Park Notebook #42 [N-79-12-19]

This notebook covers the period December 1879-June 1880. The entries are by Edison, Charles Batchelor, and Francis Upton and relate to electric lamps. Included are notes, drawings, calculations, and tests of lamps; a caveat by Edison; and drawings by Batchelor of a glass blowing machine for making lamp bulbs. There is also a set of notes about lamps burning at Menlo Park, which appear to be in the hand of Albert Herrick. The book contains 264 numbered pages.

Blank pages not filmed: 6-7, 28-29, 32-33, 46-47, 60-61.

Missing page numbers: 37-38, 261-262.

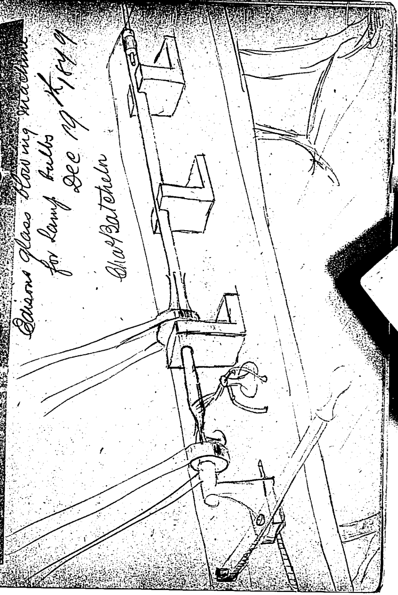
No 42

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

Frank L. Dyer
[illegible] St. N.Y.
[illegible], 189

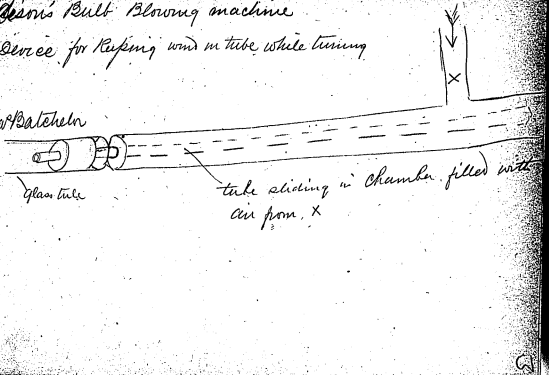


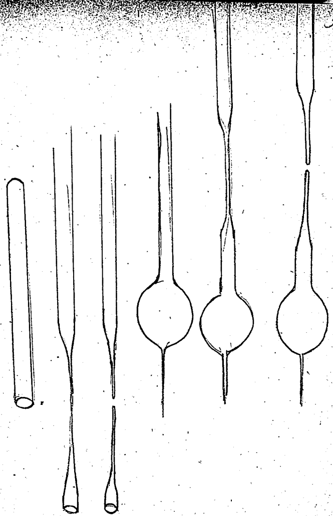
Edisons glass blowing machine
for lamp bulbs
Dec 19th 1879
Chas Batchelor

Edison's Bulb Blowing machine

Device for Keeping wind in tube while turning

Chas Batchelor


X
glass tube
tube sliding in Chamber filled with air from X



100 ohm	100
outside	in Battery
FP	
550	550
100 ohm	50 ohms 2 series
4900 —	2450

49
100
4900.

150 / 7333 (4~~8~~9
600
1333
1200
133.

49
50
2450

50.
50
2500
44
10,000
10000.
2~~00~~ / 110.0.~~0~~

125 / 1100.00 (880
1000
1000.
1000
— 0

125

150 / 1100.00 (733~~1~~
1050
500.
450
500
450
500.
450

733~~1~~
+150
36665 0
7333
1099.95 0

50
50
2500
44
10000
10000
11000

225

150 / 733 (5
150

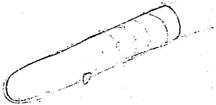
200 / 110 000
550

150 / 110 000 (733
1050
500
450
500

550
200
110000

100
275
~~300~~
508
700

Batty
100
275
225
180



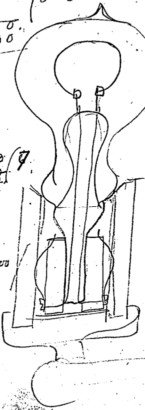
Dec 28 1879

T.A.E

25 / 110000 (880
1000
1000
1000

125 / 880 (7
875

112 / 110 000



83
83
249
664
6889
44
27556
27556
302116

90
90
8100
44
32400
32400
356400

262) 356400 (1360
262
944
786
1580
1572
80

1360
20

1360
24
5440
2720
32640

Portland Feby 6 1880

609 -

Foot Lbs. ——— 1169. 28 per H.P.

Resistance Hot 262 ohms Cold 480.

—

609 - measured cold after running several hours was 480 still

with 90 volts no change

over 83 volts R was

264 - shewing apparently

that there is a point where

dec of R stops

increase commences

with 90 volts 24 per hp

75
75
375
525
5625
44
22500
22500
285) 24750 (868
2280
1950
1710
2400
2280

3

868

50
50
2500
44
10000
10000
110000

65
65
325
390
4225
44
16900
16900
185900

Feby 6 1880.

244 ft lbs

45 - Volt 89100. R 365
50 " 110,000. R 327 — 336. ft lbs
55 133100 R 312 - 426 ft lbs
60 158400 R 306 - 517. ft lbs
65 185900

55

327) 110000 (336
981
1190
981
2090
100 1962

365) 89100 (244
730
1610
1460
1500
1460
1400

306) 158400 (517
1530
540
306
2340
2142

100) 89100 (
891.

312) 133100 (426
1248
830
624
2060
1872

45
45
225
180
2025
44
8100
8100
89100

409 Put in chemical Labratory by
Edison Res.1/

Commenced burning at | Jan. 15/1880
9.40 A.M.

Taken over to office

55
55
275
275
3025
44
12100
12100
133100

60
60
3600
44
14400
14400
158,400

Page 9.#

410 Put in chemical laboratory by Edyson Res.

Commenced burning at | Jan. 15 1880. 9.40 AM

Taken out by [illegible]

How many Lamps Has [illegible] and where

19hrs to long did [illegible] say his light

and during [illegible] burns

---

419 Jn Chandelier by organ

put in by — North side

Res 128

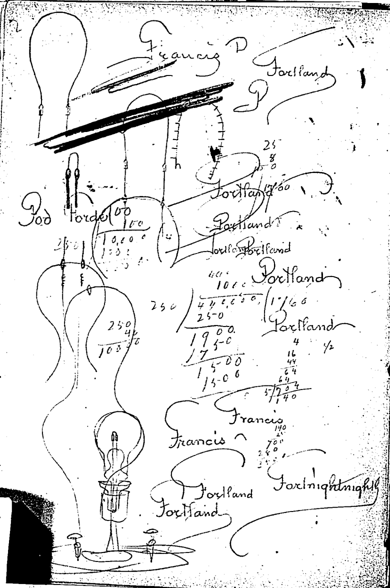
Commenced burning at | Jan. 14. 1880

4. 40 P.M.

Busted after burning at 19 hrs

403 Jno Chandelier by organ
put in by — at South side
Res. 142
Commenced burning at — Jan. 14/1880
4.40 P.M.

Busted after running ~~4~~ 3 hours


Francis D
Portland
25
8
150
Portland 1760
Portland
Portland Portland
Pod Portd 100
100
10,000
250
400
1000 Portland
250
1766
250
Portland
1900
1750
1500
1500
4
½
16
44
64
64
140
Francis
Francis
Portland
Portland
Fortnightnight

410 Hanging on wires by Mr. Kenney's work-bench in Laboratory

Res. 117 —

Commenced burning at— | Jan. 14 1880 10.00 P.M.

Put on trace over pumps by Mr Zagla

23

Jan. 3 19.30
" 4 9.58
" 5 23.47
" 6 20.26
" 7 12.15
" 8 22.00
15 11.00 " 9 15.50 total time burned 173.12
16 23 00
17 11 00 " 10 19.15
" 11 7.00 " " " 217.17 noon
" 12 20.00
" 13 22.30 " " 239.47
" 14 22 30
" 15 11 30 after noon 294.17

226.31

700
20.00
22.30
22.30
11 30
~~83.30~~

83.30
11
94.30
23.00
11.00
138.30

24

411 hanging on two main wires ~~at~~ over pumps one nearest window

Res. 182

Commenced burning at | Jan. 14. 1880 — 10.00 P.M.

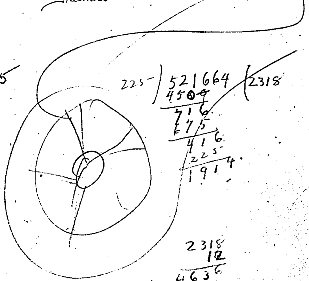
Broke after burning 12 hours

138

5.03
189
115.03
322
40
362
23
243
383
33
32
35
12.20
6.80
5.40
322
15
307
50
35
15
16
17
11

89100

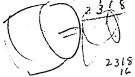
Francis Cornishmineralogistically



225

225) 521664 (2318
4500
716
675
416
225
1914

2318
12
4636
2318



100
104
416
104
104
11856
44
47424
47424
521664

2318
13
6954
2318
30134

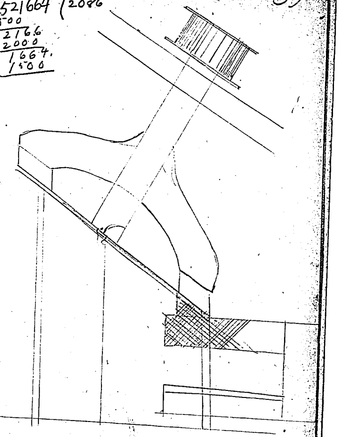
2318
14
9272
2318
32452

2318
16
13908
2318
37058

2[illegible]) 521664 (2086
500
2166
2000
1664
1500

6

16½



84
3
252.

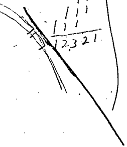
85
3
255

85

11
35
53

111
111
111
111
111
12321

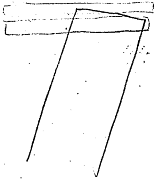
2



262
264

12321
44
9284
44284
542124

346'



75
15
40
20
150
45
3
198

---

162 dif Lamie

262 Rio —

204 ohm

260) 521664 (200
520
16

260
2 000
520000

304) 542124 (1454
304
1381
1216
165~~304~~2
1520
1324

11 28,

88
3
264 87
3
261.

330.

262

115
115
575
115
115
13225
44
52900
52900
581900

389/581900.(15
383
1989
1915
1915
40

165

310.

389/1490(3
1167
323.

3

20 4

389/581900(1490
389
1929.
1556
3730
1

8

1470
22
2940
2940
32340.

1490
20
9800

1490
24
160

22.

88
3
264

88
88
704
704
7744
44
30276
30276

86) 333036 (38
258
750

---

320. Lamp. 135 Res.

320. 8.6 ohms

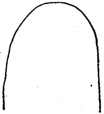
86) 343060 (3989
258
850.
774
766.
688
780
784

3988 398
8
31904

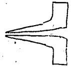
181
181
181
1448
181
32761
44
131044
131044
1441484

181.

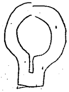
700 / 1441484 / 2059
1400
4148
3500
6484
5600



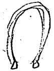
Caveat,



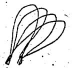
drawplate for fibre



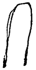
soaked in standard solution sugar dried and cut.
Alcoholic Solution with slight amount H_2O to render it more soluable.



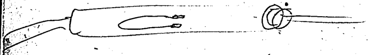
sugared Ends continuation several loose fibre



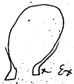
separate fibre sugared Ends or lignum Vitae Ends & little sugar on



burner made of a great number of fibres + held together with Sugar – Extra fibre at ends also held by sugar, or any carbonizable ~~th~~ Viscous liquid –

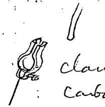


passing vapors of Hydrocarbons or carbonizable gases through Hot tube to build up by deposit,

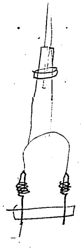


x Extra piece at X + all sugared

Clamp



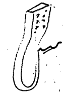
clamp for round Carbons.

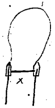


split wire taper outside to Hold Carbon ring tighten.

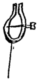
Wood Ends in spiral, sugared on platina + wood.

Roughened clamp



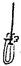


x pean large Carbon to heat clamps drive air away

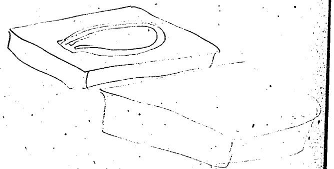


nickel clamps.

platina Iridium with Iridosmine let in where Carbon Comes in Contact, also gold - Silver, ~~Co~~ Chromium. Ele etc -

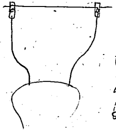


platinum Iridium screw - hole through Carbon

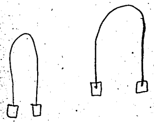


No tissue let it take its Shape.

blowing bulbs through Cotton,
plaited or braided fibre,
Sugared thread,



bias of clamps
towards each
other keep from
breaking



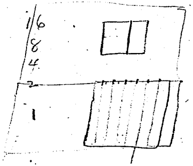
paper Ends
Sugared

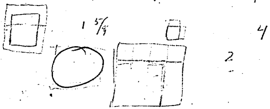
24 —
9
216.

28·8 cm

24 —

26
13
$6\frac{1}{2}$
$3\frac{1}{4}$
$1\frac{5}{8}$





Rec'd pg 131 Caveat Book

Mott

The object of the invention is to ~~[illegible]~~ obtain light by the incandescence of Electric Conducting matter,

The invention consists in various methods of manufacturing the lamp

I have found that when paper ~~[illegible]~~ is used that it should be specially manufactured ~~and that pure cotton rags well washed~~ so as to obtain pure Carbonizable fibre without sizing and other foreign materials Ordinary Bristol board contains Rosin & other ingredients ~~for rendering~~ it non porous to inks, this rosin carbonizes ~~and~~ as well as the fibre, and being in some lots of paper in greater or lesser quantity makes it very difficult to obtain incandescent conductors of the same degree of conductivity when subjected to the same carbonizing processes. To obviate this I obtain the paper free from such matters and after cutting the pieces of paper to make the conductor in a larger form than the final cutting I ~~soak~~ boil these in a solution of sugar in alcohol or alcohol & water or in a

Water solution of sugar. The strengths of these solution must be such that the required resistance is obtained if a low resistance is required a thick solution of sugar should be used ~~but~~ and if ~~the~~ a high resistance the strength of the solution must be diminished, ~~by this means~~ ~~[illegible]~~ The horse shoe form of burner which I have shown in ~~an~~ application has thickened ends ~~up~~ which serve to make good contact with the clamps, I now cut out another piece or 2 pieces of a shape Exactly like these thickened Ends. I place one on Each side moistening them slightly with a syrupy solution of sugar, this serves to hold them in their position and when Carbonized the sugar Carbonizes as well and thus makes a solid piece which allows of better Clamping,

I also have succeeded in plating these Ends with copper nickel & other metals. which serves to make Excellent Contact between the clamps and the Ends, I effect the deposit by hanging the loops upon a wire which is connected to one pole of a battery & allowing the ends of the loops to dip in the plating solution the proper distance, the jar containing the plating solution being in contact with the other pole of the battery.

In using long ~~[illegible]~~ fibres such as Manilla hemp & other fibres of the Hemp family I also plate the ends very thickly and afterward drill holes in the metal deposited by electro deposition tap the same & put in ~~the~~ a short length of platina wire

These ends are secured to the platina wires passing through the glass by a collar or clamp.

I makes lamps consisting several fibre each spread out but all coming to a common clamp, but in this case the aggregate radiating surface of all the fibres do not exceed that of a single paper horseshoe conductor.

I also bunch all these fibres together & pass the aggregated filament through a solution of sugar to hold them together on single & Even on an aggregation of distinct fibres I Secure their Ends to a piece of Carbonizable wood such as lignium Vitae, boxwood, Cocanut shell, Bass fibre; by drilling a small hole in the wood & drawing the fibre through this hole & putting a slight amount of sugar on the wood the whole is Carbonized & gives a good thickened End for clamping ~~the~~ a short piece of platina wire Being placed in one End of the wood & put in the mould when the fibre is Carbonized the wood shrinking

serves to clamp itself upon the
platina with great force
as these clamps of carbon contain
a large quantity of gas which
comes out very slowly in the
vacuum; It is best to employ
clamps of carbon which have
been carbonized and subjected
to high incandescence in
vacua to free it from air. Small
pieces can then be used with
fibres for ends, a very small
quantity of sugar serving
to lock the fibre to the clamp
in the act of carbonization

Paper horse shoes or burners made of fibre, may be (after Carbonization) placed in Combustion tubes or platina wires and a hydrocarbon vapor passed through the tube by the aid of a Bunsen water vacuum pump. the Hydrocarbon being decomposed) a very hard Carbon is deposited upon the shaped Conductor, The most perfect fibre for carbonization and use for lighting by incandescence or for arc purposes is ~~A~~ fibrous grass from South America called Monkey Bast fibre, Each blade of grass which are generally round is ~~fibre~~ composed of a great number of fibres and the whole cemented together with a natural resin which serves to carbonize & lock all the other fibre together, making a nearly homogeneous filament, These ~~fibre~~ blades of grass ~~are~~ are of various sizes from $\frac{1}{16}$ of an inch in diameter to $\frac{5}{1000}$ of an inch, they are slightly taper hence, I make a cutting die, through which I pull the fibre. the edges of the die serve to shave off the Extra matter of the thickened End, another plan is to use a revolving cutter, the Cutter revolving and is passed along the fibre,

Theses fibres when small may be put between paper ends which are sugared & then Carbonized or a small platinum Iridium wire, may have a hole drilled in the end about the size of the fibre after carbonization the wire is split to the bottom of the hole or lower, the fibre is placed in the hole & [illegible] the outside of the wire is made slightly taper a ring may be placed over it thus clamping the fibre very tightly

In carbonizing in moulds we have sometimes dispensed with the tissue paper between each of the paper shoes or fibre shoes with the weight on top and instead ~~only~~ ~~[illegible]~~ made a small indent into ~~the~~ a nickel plate having a depth a little greater than the thickness of the paper over this another nickel plate is placed if a paper ~~horse~~shoe is placed in this recess & the top plate put on it lays in a very thin chamber, but is free to contract. the two plates are placed in the nickel box and then passed through the Carbonizing process, the Shoe will, being free from restraint, Contract in a somewhat irregular shape but it will ~~So more~~ have less flaws and withstand a higher incandescence,

As platina Combines to a certain Extent with heated Carbon I let into the Ends of my clamps ~~where the platina~~ thin plates of Iridosmine, which does not to the same extent Combine with Carbon; Gold Chromium manganese chrome iron silver +many other metals may be substituted for ~~the~~ Iridosmium but whether they will last for long periods of time I am now ascertaining.

I sometimes roughen the surface of my platinoid clamp so as to Ensure better Contact, I also instead of placing the tightening screw some distance from where the Carbon is clamped. Cut a hole in the thickened part of the shoe before carbonization + then

place the shoe in the clamp &
put the tightening screw through
this hole

I ~~sometimes~~ have, wound a small
spiral which forms a sort of a cup
and secured one of these spiral
to Each of the platina wires which
is sealed in the glass, in the
Cup, I force the round Carbonized
wooden Ends of the fibre.

I distributing both power and
light & whether there ~~~~ is a
difference of price to be charged
for Electricity when used for
light or power, I place a double

meter in the ~~[illegible]~~ house of the consumer and connect the leading wires of the light to one meter & Extra leading wires to the magnetic motors to another meter,

As the motors will for different purposes be required to run fast or slow, I provide each with a governor which when the speed increases above a certain rate opens the circuit & disconnects the motor from the main wires.

and as it falls ~~off~~ in speed
closes the circuit again, as it
would be entirely impracticable
to use an ordinary one point
[illegible] circuit opening & closing
magnetic governor owing
to the great spark due to the
Extra Current of the induction
bobbin & field magnet I use
several points & springs so
arranged that the circuit
is opened simultaneously
in several places & thus
so reduces it on any one single

point so as to practically obliterate it as far as any special distraction of the contact points are concerned.

It is obvious that the governor may be run on the main shaft of the motor or ~~f~~ separately, motion being given it by gear wheels ~~or~~ worms & wheels or belts connected to the main shaft. ~~I [illegible]~~

~~use a smaller shaft cut~~

There is a deficit in the slow carbonization of organic filament

See page 105

No

75
75
375
525
5625

5625
44
22500
22500
247500 (913

271) 2475
2439 0.
361
271 0.
893
813

6

70
70
4900
44
19600
19600
215600 (748

288) 2156
2016 0.
1400
1152 0.
2480
2304

Candlepower Judged from 100 ohm lamps

45 volts	R 365	—	244 ft lbs	— $\frac{1}{10}$	candle
50 "	R 327	—	336	— "	"
55 "	R 312	—	426.	$\frac{1}{4}$	"
60	R 306	—	517	1	candle.
65	R 292	—	636	— 2	candles
70 —	R 288		748	4	"
75	271.		913	6	
80	—			8	

95 200/440 ...

95
95
475
855
9025

81

90

9025
44
36100
36100
397100

237/397.000 (167
237
1600
1422
1780
17800

70
70
4900
44
19600
19600
215600

1670.

9
6400
44
25600
25600
75 281600
75
375
525
5625
44
22500
22500
247500

100
100
44 10000
10000
44000

85
85
425
680
7225
44
28900
28900
317900

[redacted]

200/44000
2200
15
90
90
8100
44
32400
32400
356400

100 ohm Lamps

45 volts.	89100.	R. 331
50	110.000	321
55	133.100.	315
60	158.400	313
65	185 900	306
70	215.600	
75	247.500	
80	281.600.	
85	317.900.	
90	356.900.	
95	397.100	
100	440.000.	

$\frac{1}{10}$ candle
no change

3/4 candle
1 $\frac{1}{2}$ candles

as then Hydrocarbons ~~of~~ are formed before Carbonization and these Hydrocarbons are ~~this~~ afterward enclosed in Carbon and are only driven off by the highest incandescence and after a long period of time to obtain a more rapid Carbonization I take a large platinum Iridium wire bend it in the form of a horseshoe form a groove in this wire two or three times the size of the fibre which is to be laid in it after this is done I put in a piece of the ~~same~~ platinum Iridium which serves to cover the slot in which the fibre is laid, the Ends of the horseshoe are secured to circuit clamps & the whole arrangement is placed in vacua, the wire is slightly heated to drive of the water vapor then brought suddenly to incandescence to Effect the Carbonization Carbon may be substituted for the platinum Iridium Even ~~[illegible]~~ Viscous substances may be carbonized in these

~~Improvements in the art of [illegible]milling and reproducing power at a distance by Electricity~~

These grooves, such as sugar, which must be enclosed in tissue paper to prevent it sticking to the platinum iridium,

T. A. E.

Menlo Park –

Lamp on pump June 25th

Paper New batteries

6250
6250
6290
6290 A
9850
34930
1-

49 = D

Slightly red
80 ∠ Δ

A + 4 ones

1½ candles

3 candle

6250
6290
6290
245 = Δ

1.9699
1.9699
1.6464
8.0264
8.7959

2.4085

3.6026

256 ft lbs. per candle

4100 ft. lbs.

Sept 1 Paper Lamp

16 candles fare
poor vacuum

~~6250~~

280 = W
93.3

155-8

6250 1-5
6290
6290

18830
94.15 ohms

1.9685
1.9685
1.6464
8.0329
8.7696

2.3859

3.6163

24.2 ft lbs per candle

4130 ft lbs total

1-55
6050
6290
6290
18630
9315
~~[illegible]~~

1-55 17 candles

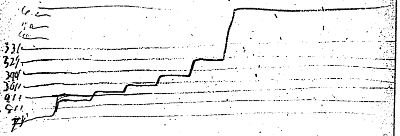
3 | 279 = D
93

~~5970~~

5970
6290
6290
18550
927

1-56 5850

278 = D


331
324
360

1.9586
1.9586
1.6464
8.0395 3.6039
14 8.7447
2.3478 228 ft. lbs per candle

4010 ft lbs

---

278 = D
17 candles

5700 Ohms
6290
6290
15280
9140 Ohms

2-2 5600
6290
6290
18180
9090
276R = D 274
273L 91.3

2-3 18 candles

1.9605
1.9605
1.6464
8.0429
3.6103 4080

1.9 | 87212
2.3315 214 ft lbs per cand

1st Test A

276.5 = D

5.600
6290
6290 90.4

2-6 | 276~~R~~ = D
272 L (Q274
91.3

2-7 | 19 Candles

5550
6290
6290
18130 90.65

2-8 | 272 L
275 R
274 Q.

1.9557
1.9557
1.6464
90.2 8.0448
3.6026 4000 ft. lbs.
1.2900
2.31.26 205 ft. lbs. per candle

(277
90.3 1.9557
1.9557
1.6464
90.1 8.0453
3.6031 4040
21 candles 1.3222
2.2809 191 ft. lbs per candle

1st Test A.

5520
6290
2-10 6290

274 R = D

2-13 19.5 candles

(271 $\frac{R}{L}$ = D
90.3

5470
6290
6290
18050 90.25

2-14 272 R = D
271 L = D

2-17 21 candles

15½ candles.	19 candles
16.	19½ "
16½.	19½.
17.	18½.
16½.	19.
16.	18½.
16¾.	18½.
16¾.	18
15½.	18
16½.	18½.
17.	19.
17½.	19¼.
17½.	20
16¾.	19½.
18.	20¼.
17¼.	20¼.
17½.	21.
8½.	[illegible]
8.	

1st test June 25 [illegible]

	20 candles
	21. "
2.18½	272. Right.
"	20½. candles
2.19.	5470. ohms.
"	6290 "
"	6290. "
2.19½	271. Left.
"	21½. candles
2.20½	272. Right.
"	21. candles.
2.21.	5450 ohms
"	12580. "
2.22	269. Left.
"	21. candles,
2.23.	65. Right. } 20 cells
"	64½. Left. }

90 ~~1.9542~~

1.9542
1.6464
Cam 90 3.6006
1.3247
2.2758

Beginning
94.1 Ohms 16 candles

End
90 Ohms 21.4 candles

1st Test A

2.24.	21.4 candles.
2.24½.	270. Lift.
"	5420 Ohms
"	12,580. / 18000 " 90
"	21.4 candles
2.25½.	272. lift.
"	21.4 candles
	Short circuit machine E.M.F. Change
2.29.	16. "
"	260. lift.
2.30.	16. candles.

1st test June 25

2.31. 5650. ohms
" 12,580. "

" 260. Right.

" 16½ candles

2.32. 16. candles.
" 258. left.

2.0½. 16.½. candles
" 260. Right.
" 16½, candles

1st Test B

2.33. 5670. ohms,
" 12,580. "

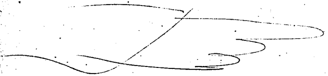
" 16. candles,
" 260. Left.
2.34 262. Right.

" 16. candles
2.34½ 16. "

2.35. 260. L,
" 5650. ohms,
" 12,580. "
" 17. candles

1st Test B

2.36.	262. Right.
"	5670. ohms
	12,580. "
"	65. Left.
" ½	16. candles,
2.37.	66. Right.
" ½	15 ½. candles,
2.38½	262. Right.
2.39.	15½. candles.
" ½	259. Left.



1st Test B

2,40 | 261. Right.
" | 15. ½. candles,
2.42 | 15. ½. "
" | 259. Left.

243 | 5700. ohms
" | 12580. "

" | 262. Right.
2,45. | Moved bar about 1.½. inches
| toward lamp.
" | Vacu quite poor.
2,46. | 260. Left.

1st Test B

2.47.	261. Right.
" ½	18. candles
2.49.	5750. ohms. 12580. ...
"	17. Candles.
"	260 Left.
" ½	16. Candles.
" ¾	262. Right.
2.51.	16. candles.
2.52.	259. Left.

94.1
91.6
2.5

1st Test B

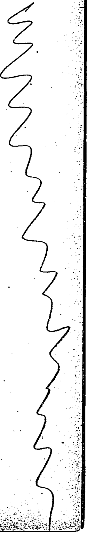
2,52.	16. candles
2,53.	261. Right.
" ,½.	16. candles.
" "	260. Left.
2.54½,	260. Right.
2,55,	14½. candles.
2,56,	258. Left
"	5750. ohms
"	12,580. "
	1833.0 91.6 ohms
"	14½. candles.
"	261. Right

1st Test B

2,58	14. candles.
"	259. Left.
2 59	5790 ohms
"	12,580. "
"	14½. candles
"	261, Right.
3.00	16. candles.
3.01.	15 "
"	260. Left.

1st test June 25 8'

3.02	16. candles,
3.03	262 Right
"	14½, candles,
3.04	14½. "
"	260 Left.
" ½	261, Right,
3.06,	14. candles.
"	260. Left.
"	261. Right.
3.07.	15. candles



End of 1st test June 25

3,07½	260. Left.
3,08,	261. Right.
" ½	13.½ candles.
3,09,	14.½, "
" ½	260. Left,
3,10½,	261, Right.
3.11,	13½, candles.
3.12,	13¼. "
"	258. Left.
3.13,	260. Right.
	13½. candles

Paper Lamp broadside

```
      1.9699
      1.9699
      1.6464
      8.0227
      ------
      3.6089      4060 ft lbs
15.5  1.1903
      ------
      2.4186      262 ft. lbs per candle
```

2d list June 25.

3,50. 18. candles

" 288. Lift.

" 6 200. ohms

Just in tube.

3 51 15½ candles

" 6400 ohms

```
 6290
 6290
 -----
18980       94.9 Ohms
```

" 280. Lift
93.3 volts

" ½ 282. Right.

" ½ 16 candles

3 5 2 6650.

Inch above tube

```
 6650
 6290
 6290
 -----
19230     96.15 Ohms
```

1.9713
1.9713
1.6464 — 5.5890
96.15 8.0173
3.6063 4040 ft lbs.
16 1.2041.
2.4022 252 ft lbs. per candle

5.5890
1.9759
3.6131 4100
19 1.2788
2.3343 216 ft lbs. per candle

2d. test June 25.

353.	280. L	281 93.6
"	282 R	
354.	19. candles	
"	2.34 in above.	
"	19 candles	
"	6350. ohms	6350 6290 6290 18930 94.6
"	280. L.	
" ½	65. R. 20 cells	
355.	19.½ candles	

5.5890
1.9782
3.6108
19.5 1.2900
2.3208

4080 ft lbs.

209 ft. lbs. per candle

2d. test. June 25th 80

3.55. 4½ in above tube.
" 64. Lift. 20. cells.
" 19.½. candles
" 6450. ohms,
6290
6290
190 30
95.15
" 282. R.
281
93.6
" ½ 280. L.
" " 19.½. candles.
3.56. 4½. in above tube
" ½ 20 candles
3.57. 6490. ohms

1.9850
1.9850
1.6464
8.0195
3.6309

4270 ft-lbs.

213 ft-lbs per candle

2d. test.

3.57.	279 Left
" ½	20 candles.
" ¾	281. Right
3.58.	4.¾ in above.
" ½	20. candles.
3.59.	6550. ohms.
4.00.	20.4. candles.
" ¼	279. Left.
4.01.	281. R.
" ½	20 candles
	Vacu within one in of top.
4.02	20 candles

6550
6290
6290
19130
95.6

280
96.6

End of 2d. test.

4.03.	20. Candles.
"	280. Left
4.04.	281. Right.
"	20 candles.

1,9759
1,9759
1,6464
7,9957
3.5939
11.5 1,0607
2,5332

3920 ft lbs
341.0

7450
6290
6290
20030
100.15 Ohms

3.5939
14 1 1461
2.44~~7~~8

281 ft. lbs per candle.

3d. dist. Bast fibre

1st time brought up

424½.	284. Left.
"	11½. candles
"	¼. in in the bulb
4,25	7470 ohms.
"	283. Right.
"	⅛. in. in bulb.
"	12½. candles
2:26.	14. "
"	282. Left.
"	1/16. in. in bulb.
"	7450 ohms
" ½	14½. candles
"	283 Right.
"	7400 ohms

94.6 Volts

4.27.	2. in in tube
"	15. ½. candles
"	282. Left.
" ½	16. candles
" "	3. in. in tube,
4.28.	283. Right.
"	16. ½ candles
" ½	7350. ohms.
4.29.	17. candles
"	4. in. in tube.
"	282 Left.
" ½	18 candles

2.30.	284. Right.
"	5.¼. in, in tube.
" ½	18.½. candles.
" "	282. Left.
" ¾	7400. ohms.
2.31.	19.¾. candles.
"	284. Right.
" ½	4.¾, in. in tube
"	17.½. candles
" ¾	7450. ohms.

page 158
3,5939
18 1.2553
2.3386 218 ft.lbs. per candle

4.32½	18. candles
"	282. Left.
433.	19. candles
"	284 Right.
" ½	7450. Ohms
4.34.	18. candles.
" ½	7480 ohms.
" 1.	282. Left.
" ¾	19. candles.
4.35.	65. Right. 64. Left } 20 cells

168

1.9494
1.9494
1.6464
7.9887
3.5239
12 1.0792
.4447

278 ft. lbs per candle

End of 3d test. June 25/80

4.30.	19. Candles
½	19½. "
4.37.	19½ "
438.	283, Left.
" ½	285. Right.
4.40	Brought down to 12 candles
	265 Left.
"	7980 ohms.
" ½	267. Right.
	89

7980
6290
6290
21560
102.8
31.45
134.25

1 — 44
2 — 176
3 396
4 704
5 1100
6 — 1584
7 — 2156
8 — 2816
9 — 3564
10 — 4400
11 — 5324
12 — 6336

25
44
100
100
1100

44
4
176

64
44
256
5-2 8256
2816

44
9
396

36
44
144
144
1584

16
44
64
64
704

49
44
196
196
2156

100

144
44
576
576
6336

11
11
11
11
121
44
484
484
5324

9
0

81
44
324
324
3564

4th. test. June 25th 1880.

4,56,	5½. candles. Bast fibre)
"	½. in. in bulb.
457.	275. Right.
"	6. candles.
"	3/8. in. in bulb.
"	10200. ohms.
5,01	274. Left.
"	8850. ohms
"	9. candles 2)1350(
"	2½. in. in tube.
"½.	276. Right.

1.9619
1.9619
1.6464
11.2.9 7.9469
3.5171 3290
9 1.9542
1.5629

365 ft lbs per candle

End of 4th test. June 25th 1883.

5.02. 273. Left. Bash.

5.04. 4. in. in bore.

5.05 9. candles.

" 10,000.
" 12,580.
22580
11 2.9
" ½ 274. Left. 91.6 Volts

5.06. 276. Right.

5.07½ 9. candles

10.100

Bast fibre Test 5. June 26

~~9=58~~ ~~Started~~

~~Filament broke~~

10 A.M. Started

20 cells

65 R

65 L

Q-14 6 candles

7

9¼

¼ inch in

12 candles

Changed so fast that I could not get a measurement F.R.U.

6300
6290
6290
6250
25130
125.6 Ohms

1.9474
1.9471
1.6464
7.9020
3.4436
12 1.0792
2.3644

2770

231 ft. lbs per candle

5500
6290
6290
6250
24330
121.6

86.6

13.5

1.9375
1.9375
1.6464
7.9151
3.43665
1.1303
2.3062

2730

202 ft lbs per candle

Test 5

265 R.
265 L
886
6300

260 Left

260 Right

5500

10,20 13½ candles

1½ in in tube

10,21 14 ¾ candles

5200

2½ in in tube

5200
18830
24030
120.15

86.6

1.9375
1.9375
1.6464
7.9191
3.4305 [illegible]
1.1673
2.2632

14.7

183 ftlbs per candle

5000
6290
6290
6250
23830
119.15

262
87.3

1.9410
1.9410
1.6464
7.9245
3.4529
1.2170
2.2354

2840
16.5
172

4700
18830
23530
117.65

88.3

1.9460
1.9460
1.6464
7.9296
3.4640
1.2430
2.2210

2910
17.5
166

Test 5

10 23 260 L
260 R

14½ candles

16½ candles

5000
6290
6290
6250
3½ min in tube

20)23830 (119.15

6290
6290
6250
18830

10 23 17½ candles

263 R

263 L

4700

1266
88.6

1.9474
1.9474
1,6464
117.4 7.9303
2960 3.4715
18 1.2553
164 2.2162
~~[illegible]~~ ft. lbs per candle

87.6 1,9425
1,9425
1,6464
117.75 7.9314
3.4628
2900 20.5 1.3118
2.[illegible]510
141 ft. lbs per candle

Test 5 June 26

10,24 18 candles

266 L.

266 R.

10,25 20½ candles

4600

20½ candles

260 L.
260 R.

80
80 6
640 44 6
6 6
25 6 0 6
256 0 6
6
2811

292 (185900 (636.
1752
1070
876
1940
1752

Test 5

Bast Regular June 26

10.26	262 L.
	20 candles
	264 L.
1028	20 candles
	21 candles
	261 L.
	261 R.

86.6 1.9375
1.9375
1.6464
116 7.9355
3.4569 2860

143 ft lbs per candle

Test 5

A.M. June 26

20 candles

6400

261 L

10:32 19½ candles

260 L

260 R

86.6 Volts

4650

4600
6250
6290
6290

4500

23230
116.

Test 5

Bast Regular June 26

10.34 19 Candles

260 L.

260 R.

4500

19½ candles

261 R.

261 L.

4500

2700
18830
2 / 21530
107.6 Ohms

(295
98.3

19926
1.9926
1.6464
8.9684
3.6000
44 1.6435
1.9565

90.5 ft. lbs

Test 5

Bast Reg Line 26

10.36 295 L.

44 candles

2700

290 L.
290 R.

10.38 66½ inches on bar.

293 L.
293 R.

2600

Test 3

Bast Rig. June 26

10.41	291 L. 291 R. 66½ inches
10.43	66¼ inches 291 L. 291 R 6450

Test 5

Bast Reg. June 26

10,44 291 L.

291 R.

66 1/2 inches

290 L.

66 1/2 inches

293 R.

66 1/2 inches

293 L.

10,54 294 L.

66'.5 = 48.5 candles

80.
66.5
13.5

1.8228
1.1303
.6925
2
1.3850

~~80~~
~~66~~
14

1.8195
1.1462
.6734

24.2
2
48.5 candles

1.9912
1.9912
1.6464
7.9751
3.6039
2.6857
.9182

4100 ft-lbs

82.8 ft-lbs

Reg Bart June 26

10.55

5 350

294 R.
98

6290
6290
6250
2350
2118 0
1059

6430

3.6039 4100
67.3 ft-lbs

Test 6 Bast Fiber Reg June 26 1880

2 test P.M

2-21 Resist cold 6290 × L

65 R } 2.0 cells
65 L }

6250 × 2
6250
6290
6290
6290
6290
7000
200)44660 2
223.

223 ohms cold.

Vacuum

5550
6290 3(260
6250 833 1.9206
6250 1.9206
1.6464
|24340 7.9149 5.4876
Ohms 121.7
2520 3.4025
5.5 0.7404
460 2.6621

~~5050~~
6290
6290
6250
18830
5050
|23880
119.4

5.4876
2.0770
3.4106 2570
8 0.9031
2.5075 .321

Test 6 June 26. P.M.

2 — 5 1/2 candles
260 Left

5550
1/4 in. in tube

8 candles
5050
260 Ri

1259

86.3

1.9360
1.9360
1.6464

118.9

7.9249

3.4433

2770

8.5

0.9294

2.5139

326

86

1.9345
1.9345
1.6464

2/350

175

118.9
1.75

117.15

7.9314

5.5154

3.4468
0.9777

2800

9.5

2.4681

294

5.5154

116.1

2.0649

3.4505

2820

.11

.6414

3.4091

257

Sept 6

8 1/2 candles

4950

9 1/2 c.

1/8 in in lute

258 L.

4600

10 c.

11 c.

4400.

Sect 6

1½ in in tube

258 R.

4200

205 12 c.

4100

257

4000

3½ in in tube

12 c

6290
6290
6250
4000
22830
114.15

85
1.9294
1.9294
1.6464
7·94~~84~~
3.4466

2790

12 1.0792
2·3674

2·33 ft lbs

Test 6

Bore 26.80

1 4000.
255 L.
12 c
255 R
3950

2 → 255 R.
4 in in lube
12 c
3800
255 L.

6250
6290
6290
3250

22080
110.4

1.9294
1.9294
1.6464
7.9586

2500 3.4638
4.5185
8.0547

1.3 per [illegible] yd. P.

3.4638
12.5 1.0969
2.3669

232 ft. lbs
per candle

Test 6

Reg Bar June 26. P.M.

2,08 12½ c.
3250
255 L

2,10 12½ c.
3250 Ohms

12¾ c.
255 R
85
3150

3650
18830
22480 | 254
112.4 | 84.6

1.9274
1.9274
1.6464
7.9493

2820

3.4505
13.5 1.1303

2.3202

209 ft lbs per candle

Seat 6

Reg Bask June 26 P.M.

2.11 13 c –

4½ cu in litre

255 L.

13½

254

3650

13½

2.12 254 L.

.15 c

3550

254 R.

3500

Test 6

Reg Box June 26 P.M.

2,14 14/2 C.

3450

254 D.

14 C.

254 R.

3500

2,15 254

14 C.

18830
1100
19930
99.6

443000   5,6464
1,9983
3.6481
1,6435
2.0046

101 ft. lbs

Test 6

same lamp.   June 26.

44 Candles

1100
300 L.
66 1/4 inches =
800

2,20   300 R.

298 R.?
298 L.?

66 1/4 inches =

400
66 1/4 inches
297 L.
297 R.

6290
6290
6250
250
19080
95.4 Ohms

Test 6

Bat. Reg at one June 26 PM

250 Upton
295 L.
66½ inches
250 U
294 R.

2.30 Steam off high Vac.

6290
6290
6250
1000
19830
99.

No- Test 7

Reg Bast fibe June 26 PM

335 | 2000 ω

8½ C.

1750

256 L.

12 candles

1400

1000

17 Candles

6290
6290
6250
1000

24 candles

5500
6290
6290
(18080
90.400 Ohms

Volts 83

1.9191
1.9191
1.6464
80438
3.5284

3370

24 1.3802
2.1482

140 ft. lbs per candle

Test 7

June 26

24 candles
after this
5500
6290
6290

250 L.

24 candles

247 L.

66 3/4 inches

280 R.

4200

4100

222

6290
6290
2700
15280
76.4

68 1.8325
12 1.0792
.7533
2
1.5066

32
2
64
12
77

74.4 ft lbs

4
1.6464
8.1169
3.763 3
5800 ft lbs

3.7633
1.8865
1.8718

Test 7

223

June 26

300 lb
3.40- 2800 lb/in
68/10 inches
2700
2800
3-45 Broke

If 8 light of 16 candles

16 1.2041 per H. P.

8. 0.

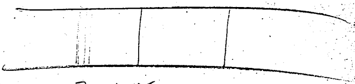
128 candles per H P.

4.5185
2.1072
2.4113

257 ft lbs per candle will give at 8 per H. P.

100 Ohms coil

6290
6290
7800
26380
101.9



31.45

240
80

1.9031
1.9031
1.6464
7.9814

3.4340
2720   4.5185

.0845

12.2 per H. P.

3.4340
1.1139

2.3201

209 ft. lbs. per candles if 13 candles

S.

2040

13 ~~16~~ candles side

6290
6290
8300

20880

104.4

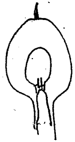
Test 8

New carbon never brought up.

June 28.

Lamp Bast fibre

Regular 0".012 X 0".012



Two plates between clamps

11-25 20 cells 65 RL

1-15 4 1/2 candle

5 1/4 "

248 L.

6250

6290

6290

8270

8000
6250
6290
6290
26830
13415

June 28

3,15 | 6 1/4 candles

8200
6250
6290
6290

248 R.

6 1/2 candles

248 L.

6 1/2 candles

8000

6 1/2 candles

June 28

290 L.

23 1/2 candles

5250

3,22 310 L.

66 3/4 inches

2500

310 R.

Test 8 June 28

3.20 67 inches

2400

308 L.

66 3/4 inches

67

309 L.

67 1/4 inches

2100 -

6 250

6 2[illegible]

6 2[illegible]

298
99.3

18,830
2500
21330
106.6

1,7969
1,9969
1,6464
7,9722
3,6524
1,6435
1,9689

93.1 ft. lbs per candle

June 28

33.8

308 L.

66¼

300 L.

2400

300 R

298 L.

2500

3,33

4100

11½ candles

245

1.9206
1.9206
1.6464
7.9435

3.4311 .2700
14 1.1461

2.2850

192 ft. lbs. per candle

4.5185
3.4311

.0874
12 per H. P

June 28.

14 candles

3 | 250 L.
833.3
3950
6250
6290
6290

22780
113.9
6 1/2 candles

4950

.223 L.

270
26 candles

3500
6250
6290
6290

June 28

67½ inches

298 L.

2600

3,40 66½ inches

2900

289 L.

289 R

2000
2000
44
4000000

33000 176000000 | 5333
165
110
99
110
99
110

5 | 5333
1066

66
5
330

1.9850
1.9850
1.6464
7.9547
3.5711
1.5345
2.0396

109 ft. lbs per [illegible]

4-15 Pump running until this time with lamps

(290 Ω
96.6

3400 Ohms
6290
6290
6250
(22230
11.115

4-30 292 Ω
3700 Ohms
290 Ω
34 candles
Very high

1.9474
1.9474
1.6464
7.9261
3.4673
14 1.1461
2.3212

209 ~~ft.~~ lbs. per candle

June 28

14 candles

$3\,\underline{)266}$ L
88.6

4800 Ohms
6250
6280
6280
23610
118.05

Calvados Galva.

~~Temp [illegible]~~

Temp air 85.0

Soft bast fibre June 29 80

~~1020 Pump started~~

20 cells 65
6250
6250
6290
11— 6290 All the loops remain cold.
6290
6290

100 L—

Carbon loops are slightly irregular

200 L

All the loops are 12,000 each

6290
6290 12,000 ohms
6290
6290
6250
6250

2.0315
2.0315
1.16464
7.7122
3.4216

13 1.1139

2.3077

2640

207 ft. lbs. per candle

Left Bath June 29.

11.10 323 L
107.6
6290
6290
6290
6250
6250
7500
38870

7.50 ohms

I tried all the connections and found them good.

194.

11.12 322 Left

322 R.

6290
6290
6290
6250
6250
6900

6900

13 Candles

June 29 80

1.15 330 Ω

22 ½ candles

6290
6290
6290
6250
6250
4700 ohms

---

350 Ω

330

1 Volt = 2 D

11 20 43 - 20 cells

230 Ω

6290
6290
6290
6250
6250
3600 ohms

June 29

10.25 230 Left

17½ candles

1128 18 Candles

232 L.

3700

240 L.

22 candles

3200 ohms

6290
6290 12,580

12580
6250 18,830

18830
6250 25080

25080
6290 31370
0

31370
6290 37,660

125 2.0969
2.0969
1.6464
7.7452
3.5854
29 1.4624
2.1230

132 ft. lbs. per candle

June 29.

11,30 250 L.

29 candles

6290
6290
6250
6250
2300
27380
136.9 Ohms

27.380
6290
2300
35970
179.8 Ohms

258

35 candles

1400 ohms

Very blue

190 L. No blue

3½ candles

8)18700~~000~~

23~~4~~58

171
27

1197
342

4617

[illegible]

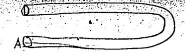
116.5 acres
100 feet
Ton. cu. yards

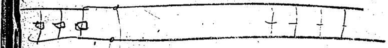
4840 sq yards in acre

33.3	1.5224
116.5	2.0654
4840	3.6848
	7.2726

18,700,000
.30

5.61 9,000.00





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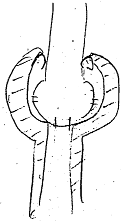
85



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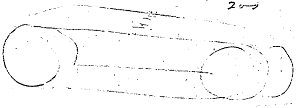
10 ,

1000
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